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"On a graphical solution of a class of differential equations occurring in wireless telegraphy" by A. A. Robb, 206–215 [Given an equation of the type $d^2p/d\omega^2 + f(p)\cdot dp/d\omega + p = 0$, the expression $d^2p/d\omega^2 + p$ may be interpreted as the radius of curvature of a curve from which by mechanical means a second curve is drawn whose polar equation is a solution of the given equation. (Compare F. V. Morley's derivation of the differential equation arising from the curve of pursuit problem, *1921*, 55)]—February: "Method of tracing caustic curves" by A. S. Percival, 258–277—March: "The relation between the projective and the metrical scales, and its bearing on the theory of parallels" by L. Silberstein, 420–429; "The deflexion of a ray of light in the solar gravitational field" by F. D. Murnaghan, 580–588; "The identical relations in Einstein's theory" by G. B. Jeffery, 600–603—April: "On products of Legendre functions" by J. W. Nicholson, 768–784—May: "Circular plates of variable thickness" by G. D. Birkhoff, 953–962.

Popular Astronomy, volume 30, June–July, 1922: "Photograph of a small tornado," 325–326; "The present position of the island universe theory of the spiral nebulæ" (concluded) by D. B. McLaughlin, 327–339; "Aberration and relativity" by W. H. Pickering, 340–343; "A universal scale for the solution of astronomical problems" by J. E. G. Yalden, 352–356 [Describes a device for the graphical solution of astronomical problems].

Proceedings of the London Mathematical Society, series 2, volume 20, part 6, February, 1922: "On double surfaces" by B. M. Sen, 417–434—Part 7, April, Prefatory Matter: "Lord Rayleigh" by H. L., xliii–xlvii; "Adolf Hurwitz" by W. H. Y., xlviii–liv.

Proceedings of the Royal Society, series A, volume 100, December 1, 1921: "The principles of internal ballistics" by J. Proudman, 289–305—Volume 101, April 1, 1922: "The design of repeating patterns.—Part I" by P. A. MacMahon and W. P. D. MacMahon, 80–94 [Abstract in *Nature*, November 24, 1921, p. 421 (see *1922*, 75)]; "Correlation between arrays in a table of correlation" by C. Spearman, 94–100.

Proceedings of the Royal Society of Edinburgh, volume 41, part 2, 1920–21: "Note on a continuant of Cayley's of the year 1874" by T. Muir, 111–116.

Quarterly Journal of Pure and Applied Mathematics, volume 49, December, 1921: "On recurrences for sums of divisors" by E. T. Bell, 186–192.

Rendiconti del Circolo Matematico di Palermo, volume 45, 1921: "On the relation between the Hilbert space and the calcul fonctionnel of Fréchet" by E. W. Chittenden, 265–270; "Orbits asymptotic to the straight line equilibrium points in the problem of three finite bodies" by D. Buchanan, 332–356—Volume 46, fasc. 1, 1922: "The Cauchy problem on the equation of telegraphy" by T. Hayashi, 117–121.

Revue générale des Sciences, volume 33, April 15, 1922: "A propos de la théorie d'Einstein" by J. Richard, 193–194; "Sur la possibilité de se représenter l'espace fini et sans bornes de la théorie de la relativité" by R. Thiry, 205–209—April 30: "Sur la notion de courbure de l'espace" by R. Thiry, 225; "Coup d'œil sur les principes fondamentaux de la nomographie en quels cas et comment ils permettent de réduire à une représentation plane des dimensions en nombre supérieur à trois" by M. d'Ocagne, 230–239; "La démonstration scientifique" by R. d'Adhémar, 239–244 (to be continued)—May 15: "La démonstration scientifique" by R. d'Adhémar, 268–276.

PROBLEMS AND SOLUTIONS.

Edited by B. F. Finkel, Otto Dunkel, and H. P. Manning.

Send all communications about Problems and Solutions to B. F. FINKEL, Springfield, Mo.

PROBLEMS FOR SOLUTION.

[N.B. Problems containing results believed to be new, or extensions of old results are especially sought. The editorial work would be greatly facilitated if, on sending in problems, proposers would also enclose any solutions or information that will assist the editors in checking the statements. In general, problems in well-known text-books, or results found in readily accessible sources, will not be proposed as problems for solution in the Monthly. In so far as possible, however, the editors will be glad to assist members of the Association with their difficulties in the solution of such problems.]

2972. Proposed by J. H. M. WEDDERBURN, Princeton University.

In *Mathematical Education*, p. 361, B. Branford gives the following approximate construction for the trisection of an angle $A\hat{B}C$. Take any point D on AB produced and make $BC = BD$; through C draw a parallel to BA and on it lay off a length $CP = CD$; then $A\hat{B}P$ is approximately $\frac{1}{3}A\hat{B}C$. Show that this construction is rendered very much more accurate by laying off on CP a distance $CQ = 2BD$ and taking in place of P, the point R which divides PQ in the ratio 5 : 4. Also show that the error does not exceed $10''$ for angles less than 45°.

2973. Proposed by N. K. CHAFFEE, Rutland, Vt.

A straight brass bar 800 feet long expands 8 inches. The ends are fixed, so that it is distorted. If the new shape is that of an arc of a circle of which the original bar is the chord, how far above the center of the bar in its original position will the center be in the new position?

It is instructive to guess at this distance before attempting to solve the problem.

2974. Proposed by the late L. G. WELD.

A man standing on a straight railway track watches a train starting from a station half a mile distant and notices that it approaches at such speed that each puff of the exhaust is heard at the same instant that the next succeeding puff is seen. How long will it be before the train reaches him, the drive wheels of the locomotive being sixteen feet in circumference?

2975. Proposed by the late ARTEMAS MARTIN.

What must be the form of the mold-board of a plow, considered as a warped surface, so that it will run most easily through the ground?

2976. Proposed by NATHAN ALTSHILLER-COURT, University of Oklahoma.

The base of a variable triangle is fixed, the opposite vertex describing a straight line. Find the locus of the symmedian point, the locus of the center of the nine-point circle, and the envelope of the Euler line.

SOLUTIONS.

2825 [1920, 186]. Proposed by the late L. G. WELD.

A ball, having a coefficient of resilience α, strikes a rigid plane surface, inclined at an angle θ from the horizontal, after falling through a height h. What is the distance from the first to the second point of impact with the plane?

SOLUTION BY WILLIAM HOOVER, Columbus, Ohio, and H. P. MANNING, Providence, R. I.

In this problem, the forces are impulsive. Let $u = \sqrt{2gh}$ be the velocity of the center of the ball when it impinges upon the plane for the first time at O; let the straight line through O directly down the plane be the axis of x, and the normal to the plane at O the axis of y; let v_x, v_y be the x and y components of the space velocity immediately after the first impact; and let X, Y be the corresponding reactions between the ball and plane, the mutual friction being such that the ball does not slip. Let m be the mass, and a the radius of the ball, and let k be its radius of gyration about a diameter.

First suppose $\alpha = 0$. Then, resolving parallel to the x and y axes, we have

$$m(v_x - u \sin \theta) = - X, \qquad m(v_y + u \cos \theta) = Y;$$

and, taking moments about the center of the ball, and putting $\omega =$ the angular velocity, we have also

$$mk^2\omega = Xa.$$

For the condition of no slipping, we have $v_x = a\omega$, and for $\alpha = 0$, $v_y = 0$. These equations give

$$X = \frac{mk^2u \sin \theta}{k^2 + a^2}, \qquad Y = mu \cos \theta. \tag{1}$$

Let v_x', v_y' be the velocities corresponding to v_x, v_y in the second case, when resilience is taken into account; then for X, Y we write $(1 + \alpha)X$, $(1 + \alpha)Y$, and the equations for linear motion become

$$m(v_x' - u \sin \theta) = - (1 + \alpha)X, \qquad m(v_y' + u \cos \theta) = (1 + \alpha)Y.$$